



(43) International Publication Date
14 November 2002 (14.11.2002)

PCT

(10) International Publication Number
WO 02/089983 A1

(51) International Patent Classification: B01L 3/02

(21) International Application Number: PCT/FI02/00397

(22) International Filing Date: 8 May 2002 (08.05.2002)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
20010972 9 May 2001 (09.05.2001) FI

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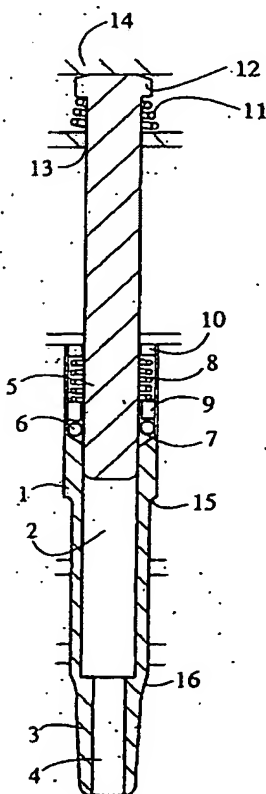
(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,
SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ,
VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: PIPETTE WITH TIP CONTAINER

(57) Abstract: The invention relates to a pipette comprising a cylinder part (1) having a cylinder (2) and a tip part (3), which comprises a tip channel (4) connected to the cylinder and a movable piston (5) tightly fitted within the cylinder for aspirating liquid into a removing liquid from the tip container and attached to the cylinder. The pipette unit of the invention is characterised by at least the tip part (3) being made of an elastic material, such as rubber. The tip container can thus be easily and reliably fixed to and removed from the tip container.



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WO 02/089983 A1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 02/00397

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01L 3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO DOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9116975 A1 (BIOHIT OY), 14 November 1991 (14.11.91), see the whole document	1-6,8,10
Y	--	7,9
Y	US 5970806 A (J.TELIMAA ET AL), 26 October 1999 (26.10.99), abstract	7,9
A	--	1-6,8,10
A	EP 0293075 A2 (HEWLETT-PACKARD CO.), 30 November 1988 (30.11.88), abstract	1-10

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

9 Sept 2002

Date of mailing of the international search report

10-09-2002

Name and mailing address of the ISA/
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. +46 8 666 02 86

Authorized officer

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

06/07/02

PCT/FI 02/00397

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
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European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

Published:

— with international search report

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1/1

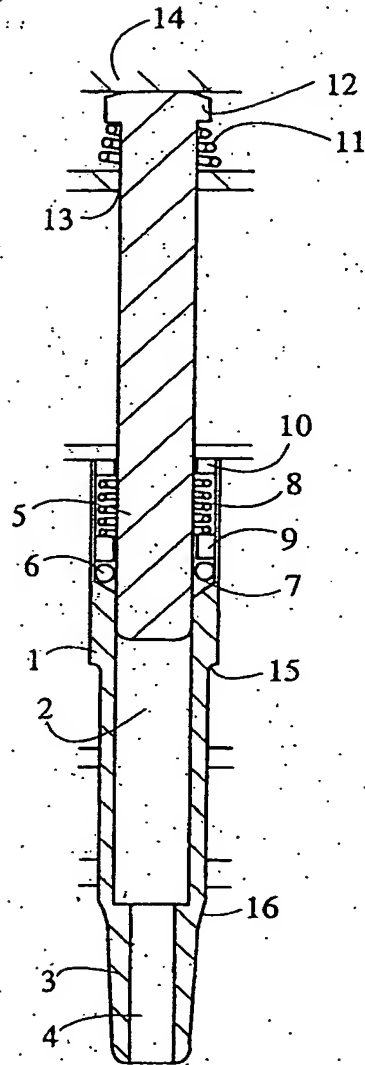


Fig. 1

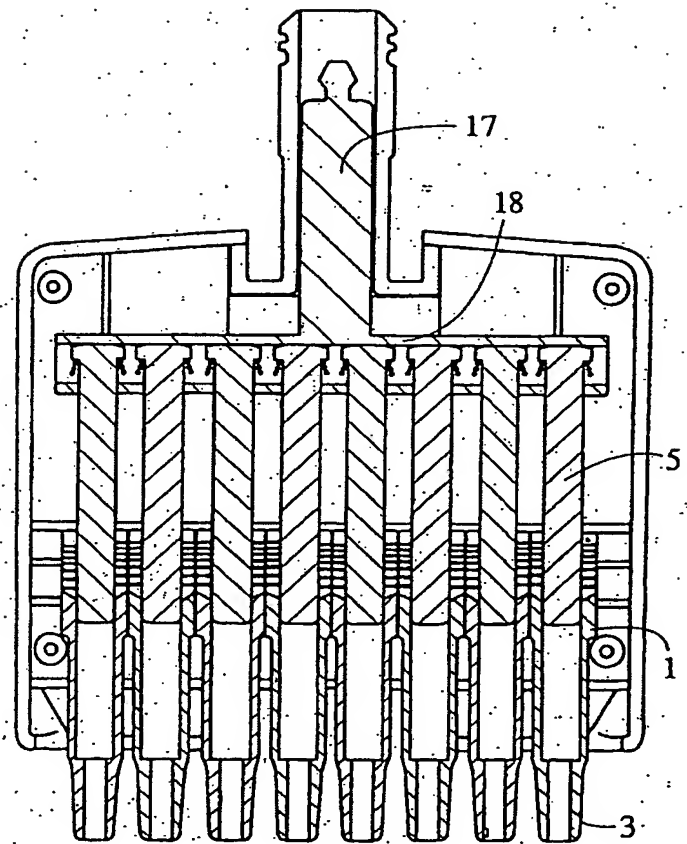


Fig. 2

Pipette with tip container

Technical Field

5 The invention relates to a pipette comprising at least one cylinder part comprising a cylinder and a movable piston disposed within this, and a tip part comprising a tip channel connected with the cylinder, a tip container being attached to the end of the tip channel for aspirating liquid with the aid of the piston.

Technical background

10 There are known pipettes comprising a tip part with circular cross-section connected to a cylinder part, a separate removable tip container, i.e. tip, being attached to the tip part. The tip is usually maintained tightly in position with the aid of a cone joint. In order to seal the tip, the tip part may comprise a separate seal, an O-ring seal, for instance, or the otherwise rigid tip part may be coated with an elastic rubber-like material. A method and a device for fixing a rigid tip part coated with an elastic
15 rubber-like material to a tip have been disclosed in FI patent specification 84789.

Currently used pipettes have the drawback of the tip being either too tightly or too loosely attached to the pipette tip part. In tip parts equipped with separate seals, contamination of the joint areas between the seals and other parts also involves a problem. In multi-channel pipettes, there is the additional problem of insecure
20 attachment of the tips or of irregular attachment of the tips as the tips are spaced by varying distances. Poor attachment of the tips may cause leakage, dosage errors or additional work in order to attach or detach the tips.

Currently used pipette tip parts have a typical hardness of approx. 78 Shore D.

Summary of the invention

25 The purpose of the invention is to provide a pipette that overcomes the problems mentioned above.

The purpose of the invention is achieved by the means described in the independent claims. The dependent claims define some preferred embodiments of the invention.

30 The pipette of the invention is characterised in that at least the tip part of the cylinder part has been prepared flexible, and of an elastic material, such as rubber, that is

softer than the tip. The tip is thus easy to attach and remove. As the tip part is being attached, it tends to be compressed to a smaller diameter, being tightly pressed against the tip. During removal, the tip is withdrawn by pulling it downwardly towards the tip part. The tip is easily detached from the tip part, because the cylinder part and the tip part stretch, resulting in a decrease of their diameter. Under these circumstances, the tip cannot be clogged as it used to be in prior art pipettes. The invention is particularly useful in multi-channel pipettes, given the compensation of the distribution error of the channels or a row of pipettes to be attached with tips. In accordance with the invention, problems caused by thermal expansion can also be reduced.

The invention also allows a pipette with a reduced number of separate parts to be achieved.

In multi-channel pipettes, the elastic tip part facilitates the gripping of tips from a tip rack. Owing to the elastic tip parts, the rack distribution may even be carried out with a slightly coarser tolerance. In addition, even inclined tips will settle more securely and at the same height in tip parts.

Measured on the Shore scale, the maximum hardness of the tip part material may be e.g. 60 shore D, such as 50 Shore D, especially 45 Shore D. The minimum hardness of the material may be e.g. 30 Shore A, such as 45 Shore A, especially 58 Shore A.

The ratio of the thickness of the tip part wall to the diameter of the tip part may be e.g. $1/10 - 1/3$, such as $1/6 - 1/4$. The diameter of the tip part may be e.g. 1 - 10 mm, such as 2 - 8 mm, particularly 4 - 6 mm.

In a preferred embodiment of the invention, the cylinder part and the tip part are made of the same elastic material.

In a second preferred embodiment of the invention, the cylinder part and the tip part are made in one single piece. In this manner, the cylinder part and the tip part are given a simple design with low costs of manufacture. In addition, as the tip part and the lower portion of the cylinder part have no separate seals with sealing grooves or similar contaminating folds or gaps, the tip part will remain cleaner and will also be easy to clean if necessary.

In a third preferred embodiment of the invention, the cylinder part comprises at least one seal that has been expanded by being pressed against the piston in order to

seal the piston and the cylinder. By these means, a leak-proof cylinder is provided using a soft material and a straightforward and space-saving design.

In a fourth preferred embodiment of the invention, the cylinder part comprises in its upper portion an O-ring seal pressed against a shoulder with a helical spring. The sealing between the cylinder and the piston is thus achieved in a simple and economical way using standard components.

Description of the drawings

Some embodiments of the invention is described in greater detail below with reference to the accompanying drawings, in which

- 10 figure 1 shows the tip unit of a pipette of the invention in vertical cross-section, and
- figure 2 shows a vertical cross-section parallel with the tip row of a multi-channel pipette made up of pipette units of figure 1.

Detailed description of some embodiments

- 15 The pipette of figure 1 has a cylinder part 1 comprising a cylinder 2, a tip part 3 having a tip channel 4 connected with the cylinder, and a piston 5 sealed to the cylinder with an O-ring seal pressed against the shoulder 7 by a spring 8. In addition, the pipette unit of figure 1 also comprises a press ring 9 for the O-ring seal and a lock ring 10 for the spring. The upper end of the piston comprises a floating mechanism for fixing the piston, comprising a piston spring 11, a piston flange 12 and a spring counter-plate 13. The force of the spring 11 is greater than the frictional force between the O-ring seal and the piston.
- 20

- In the pipette unit shown in figure 1, the cylinder part 1 and the tip part 3 are made in one piece of the same rubber-like material. The outer surface of the cylinder part has been shaped to match the shape of the tip to be fixed to its lower part, and on the other hand, to adapt to the requirements of its inner components. A shoulder 15 is provided slightly above its central point. Above the shoulder, the outer diameter of the cylinder part is greater than the lower portion, as shown in figure 1. The cylinder 2 located within the cylinder part extends from the upper portion of the cylinder part to the upper portion of the tip part, where it is connected to the tip channel 4 of the tip part. At the upper portion of the cylinder part, there is a part having a larger inner diameter for the sealing mechanism extending from the upper end of the
- 25
- 30

cylinder part within the cylinder. Said sealing mechanism consists of an O-ring seal 6 placed in the part having a larger inner diameter, the O-ring seal being expanded parallel to the cylinder radius by pressing it from above against a shoulder 7 provided underneath it by means of a press ring 9. The force required for pressing is generated by a spring 8 placed within the part having a larger inner diameter in the upper portion of the cylinder. The spring is tensioned between the press ring 9 and the lock ring 10. The lock ring is attached to the upper portion of the cylinder by means of a plate structure attached above the cylinder.

A reducing part 16 having more marked conicity than the tip part is provided between the cylinder part 1 and the tip part 3. It is intended to act as a transitional zone between the cylinder part and the tip part, producing adequate thickness of the tip channel connected to the lower end of the cylinder and thus adequate stiffness of the tip part relative to the cylinder part, so that the material elasticity will be distributed relatively evenly between the cylinder part and the tip part as the tip is being attached. Centring of the elasticity to the cylinder part under the effect of a tip part markedly stiffer than the cylinder part would entail more difficult fitting of the tip and thus deteriorated tip tightness and adhesion.

The tip part 3 has been shaped appropriately conical for the tip fitting the pipette unit to be fixed in position as easily as possible at the fitting stage and removed at the detaching stage. A tip fitting into the pipette unit of figure 1 has an upper portion that matches the shape of the tip part. At its lower portion, the tip usually has an appropriately conically shaped end known *per se*. The tip may be made of e.g. plastic, glass or any other material that is sufficiently rigid and otherwise suitable for this purpose as such as tip material for the sample substance.

Figure 2 shows a multi-channel pipette made up of the pipette units of figure 1. It comprises eight pipette units fixed to the same frame. In order to move the pistons of the pipette units simultaneously, one single horizontal plunger member 18 connected to the plunger arm 17 has been fitted in the pipette. The pipette units have been fitted at the same height and the same mutual distance. Using the multi-tip pipette of figure 2, the tips are fixed by inserting the tip parts e.g. into tips placed at the tip part intervals in a suitable mounting rack. The pipette usually comprises a tip removing mechanism, by means of which the tips fixed to the tip part can be pushed so as to be detached from the tip part.

The design and the materials of the different parts of the pipette unit of the invention may vary. Unlike the preferred embodiment described above, the pipette unit

may also comprise a cylinder part made of any rigid material, to which a tip part made of an elastic material has been connected. Unlike the design of figure 1, the cylinder part and the tip part may further be made of separate pieces, yet both made of a suitable elastic material, which may or may not be the same. The cylinder part and the tip part may have a shape different from that of figure 1, for instance shaped in some other way to match the shape of the inner surface of the conical tip. The size and tightness of the cylinder, the tip channel and the piston may also be carried out in many different ways. They can be determined as desired, for instance on the basis of the design and the material of the cylinder and the piston, and of the substances to be handled with the pipette. A support structure of a harder material, such as a ring, may be attached to a tip part made of an elastic material.

The pipette unit of the invention may be provided in a single-tip pipette, or a multi-channel as shown in figure 2 can be formed of pipette units. The remaining components of a pipette formed of pipette units may be carried out in any manner suitable for the pipette of the invention. The pipette may also be electrically driven and/or equipped with electric measuring devices.

Claims

1. A pipette comprising a cylinder part (1) having a cylinder (2) and a movable piston (5) fitted within this and a tip part (3) having a tip channel (4), which is connected to the cylinder and to whose end a tip container has been fixed by friction,
5 characterised in that at least the tip part (3) is made of an elastic material, such as rubber, softer than the tip container.
2. A pipette as defined in claim 1, in which the cylinder part (1) and the tip part (3) are made of the same elastic material.
3. A pipette as defined in claim 1 or 2, in which the cylinder part (1) and the tip
10 part (3) are made in one single piece.
4. A pipette as defined in any of the preceding claims, in which the material of the tip part (3) has a maximum hardness of 60 Shore D, such as 50 Shore D, especially 45 Shore D.
5. A pipette as defined in any of the preceding claims, in which the ratio of the wall
15 thickness of the tip part (3) to the tip part diameter is $1/10 - 1/3$, such as $1/6 - 1/4$.
6. A pipette as defined in any of the preceding claims, in which the cylinder part (1) has at least one seal (6) expanded by being pressed against the piston in order to seal the piston (5) and the cylinder (2).
7. A pipette as defined in any of the preceding claims, in which there are at least
20 two cylinder parts (1).
8. A pipette unit having a cylinder part (1) comprising a cylinder (2) for a piston movable within this, and a tip part (3) having a tip channel (4), which is connected to the cylinder and to whose end a tip container can be fixed by friction, characterised in that at least the tip part (3) is made of an elastic material, such as rubber,
25 softer than the tip container.
9. A method for manufacturing a multi-channel pipette, characterised in that at least two pipette units of claim 8 are combined.
10. A method for ensuring the attachment of the tip container of a pipette to the cylinder part of the pipette, in which there is a cylinder for a piston movable within
30 this, and a tip part, in which there is a tip channel connected with the cylinder and to whose end the tip container is fixed by friction, characterised in that the tip such as

rubber container is attached to a tip part made of a material, softer than the tip container.